district. In Alabama, eastern and northern Mississippi, and northern Louisiana the frosts were heavy and killing; in southwestern Mississippi and southern Louisiana light frost was reported. At Mobile the minimum temperature was 40°, and at New Orleans 46°, the lowest previous record for the third decade of October being 34°, at Mobile, and 42° at New Orleans. November 18 is the earliest date on which freezing temperature has ever occurred at New Orleans, and November 2 is the earliest date of freezing temperature at Mobile.

In central Mississippi and northern Louisiana, and also in northern Alabama and northern Georgia freezing weather has occurred in the third decade of October. The earliest date of heavy frost at Mobile was November 2, 1874–1878. The earliest date of heavy frost at New Orleans was November 11, 1877.

The first heavy frost has occurred as late as December 29 at Mobile, while at New Orleans November and December have in a number of years failed to show the occurrence of heavy frost. The average date of first heavy frost is November 22 at Mobile and December 7 at New Orleans.

The average minimum temperatures for the region referred to range from 50° to 55° during November, with occasional periods of freezing temperature.

The occurrence of light frost Tuesday morning, supplemented by heavier frosts and lower temperature this morning, may be considered unfavorable for the further progress of the disease. Present conditions indicate frost, and temperature 40°, or slightly below, to-night in Alabama, Mississippi, and in the interior of Louisiana. The temperature will probably remain for several days below the seasonal average, which is 66° at New Orleans and 65° at Mobile.

Acting upon the information contained in this bulletin, Edmond Souchon, President of the Louisiana Board of Health, issued the following proclamation, October 22, 1898:

Whereas, the Weather Bureau reports frosts occurring all over the State, and, whereas, it is a fact accepted by epidemiologists that no foci of yellow fever can be established in any place after frost is shown; therefore, be it ordained that all quarantine restrictions on traffic are hereby removed by the Louisiana State Board of Health, as far as it is concerned.

THE CHICAGO FORECAST DISTRICT.

Two storms of marked intensity caused dangerous gales over the upper lakes during the month. The first developed in the middle Mississippi Valley on the night of the 16–17th and remained nearly stationary for forty-eight hours. During the 17th and 18th the following maximum wind velocities occurred: Chicago, 63 southeast; Milwaukee, 40 south; Alpena, 38 southeast; Sault Ste. Marie, 38 southeast.

Storm signals were hoisted at all upper-lake ports at 9:30 a. m., October 17, giving ample warning of the gale.

The second storm was centered over northern Illinois the morning of the 25th, and it moved northeastward over lower Michigan during the succeeding twenty-four hours. The storm was attended by northerly gales, resulting in considerable damage to shipping on Lake Michigan and destroying much property along the shore in Chicago. The following maximum wind velocities occurred: Chicago, 48 north; Milwaukee, 40 north; Green Bay, 36 north; Marquette, 30 north. The wind forecast for the upper Lakes on the morning of the 24th was as follows:

Lake Superior, brisk and possibly high northerly winds; lakes Michigan and Huron, brisk and possibly high southerly winds, shifting on Michigan to northerly this afternoon or to-night and on Huron Tuesday morning.

Moreover, vessel masters leaving the port of Chicago during the afternoon and evening of the 24th were cautioned that strong northerly winds would be encountered farther down the lake. Some remained in port, while others proceeded on their way, intending to seek shelter in some harbor on the west shore as soon as the storm should strike. Storm signals were ordered up at all ports on the 25th, at 10:30 a. m., except Duluth, Chicago, and Grand Haven sections, the two latter being ordered at 3:30 p. m. The force of the storm was really centered over Lake Michigan, and the forecast for that lake, issued the morning of the 25th, was as follows:

Winds shifting to brisk and high northerly, probably becoming dangerous; rain to-night, possibly turning to snow flurries.

Although the maximum wind velocity from the southeast at Chicago on the 17th exceeded that from the north on the 25th by 15 miles per hour, there was no appreciable damage to shipping or property at the southern end of Lake Michigan during the former storm, yet on the 25th the tremendous sea, caused by the northerly on shore gale, wrought great havoc. It is also interesting to note that both these storms developed from long drawn out troughs of low pressure, which were apparently without distinct centers twelve hours previous to their development.—*H. J. Cox, Forecast Official.*

The following report of the storm of October 25 and 26 was made from Milwaukee on October 31, to the Secretary of Agriculture by the Chief of the Weather Bureau:

This storm stranded one vessel on the beach at Chicago, one at Milwaukee, another at Michigan City, Ind., and totally destroyed the steamer *Doty* off Racine, her crew of seventeen being lost. The Weather Bureau completely warned mariners of the coming of the storm by means of numerous messages distributed among the docks of all lake ports and by flag signals during the day and lanterns at night. I was in Chicago on Monday and personally supervised the action of Mr. Cox, who ordered the signals displayed. I make this statement because a rumor was started that the Bureau had failed to give warning of the storm. This rumor was quickly corrected by the press. I inclose a clipping from the Chicago Chronicle, and have marked a quotation from the statement of the cook on the consort of the *Doty*. This woman states that their vessel left Chicago harbor in tow of the *Doty* at a time when storm signals were flying.

I know of several vessel owners in Milwaukee who, in public, have congratulated themselves on the fact that they took heed of the warnings and ordered their craft held in port. It is probable that many scores of lives would have been lost, instead of seventeen, had not danger signals been displayed.

In this connection I desire to emphasize the fact that it is possible for a storm to strike the lake region without the Weather Bureau being able to give warning of the same, although such a condition has not occurred for a long time. Several times during my service of twenty years in the Weather Bureau I have seen storms develop in Iowa just after the regular observations were taken, and reach a few of the lake ports before warnings could be distributed. Happily such occurrences are rare.

SAN FRANCISCO FORECAST DISTRICT.

Rain warnings were distributed throughout the raisin drying district of California on the 1st, 7th, 21st, 22d, 29th and 31st, and to the fruit growing district north of Santa Cruz and Stockton on the 14th. All these warnings were fully verified. Although on one instance no rain fell at Fresno, showers prevailed throughout the greater portion of the San Joaquin Valley. There was no instance during this raisin drying season when rain occurred without warning, and no warning was issued without being fully verified. Probably 90 per cent of the crop was protected on account of the warnings, and the injury this year was very small indeed. The value of the crop probably amounts to $2,500,000, which would possibly have been reduced one-half without the protection of the bureau, and might have been utterly destroyed.

RAIN FORECASTS.

Weekly Citrograph, Redlands, Cal., October 15, 1898:

Warnings sent out by the Weather Bureau to the raisin and prune growers in the last two or three weeks gave ample time to stack and save their fruit. The saving to the growers is tremendous, much more than enough to pay the cost of the service for many months. When the farmer feels like kicking because some particular prediction does not happen to fit his particular ten-acre patch, just let him add his voice to the general clamor for more stations, because the more stations the more accurate the predictions can be made.

The warnings during the greater part of this month were issued by Mr. G. H. Willson, the writer being away on leave of absence.—*W. H. Hammon, Forecast Official.*

PORTLAND, OREG., FORECAST DISTRICT.

Signals were ordered up on October 12th, 13th, 16th, and 25th, and frost warnings were issued on the 3d, 15th, and

19th. No special benefits have been reported from either.

Winter weather conditions appear on the 1st, which fact was announced on the map of that date.—*B. S. Pague, Forecast Official.*

AREAS OF HIGH AND LOW PRESSURE.

During the month eight highs and the same number of lows had sufficiently well defined tracks to be followed. (See Charts I and II.) In the accompanying table will be found some of the principal points regarding the first and last appearance, duration, length of track, and apparent velocity of these areas, and the following description, more in detail, is added.

Movements of centers of areas of high and low pressure.

Number.	First observed.			Last observed.			Path.		Average velocities.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long W.	Length.	Duration.	Daily.	Hourly.
High areas.		°	°		°	°	*Miles.*	*Days.*	*Miles.*	*Miles.*
I	1, p.m.	52	115	7, p.m.	41	68	2,670	6.0	445	18.5
II	6, p.m.	48	108	10, p.m.	39	69	2,670	4.0	668	27.8
III	8, a.m.	37	124	13, p.m.	40	70	3,050	5.5	555	23.1
IV	11, p.m.	46	127	21, p.m.	45	60	5,460	10.0	546	22.7
V	14, p.m.	42	126	17, p.m.	42	109	1,680	3.0	560	23.3
VI	18, a.m.	47	122	26, a.m.	48	55	5,470	8.0	684	28.5
VII	23, a.m.	53	107	29, p.m.	48	61	4,200	6.5	646	26.9
VIII	26, a.m.	43	126	4, p.m.*	43	62	4,380	9.5	461	19.2
Total							29,580	52.5	4,565	190.0
Mean of 8 paths							3,698		571	23.8
Mean of 52.5 days									563	23 5
Low areas.										
I	†29, p.m.	21	71	6, p.m.	47	54	3,510	7.0	502	20.9
II	†30, p.m.	40	111	2, p.m.	51	99	1,140	2.0	570	23.8
III	8, p.m.	53	115	12, p.m.	49	55	3,000	4.0	750	31.2
IV	12, m	43	99	16, p.m.	48	55	2,310	4.5	513	21.4
V	13, p.m.	52	117	19, p.m.	48	88	3,180	6.0	530	22.1
VI	18, p.m.	32	102	23, p.m.	47	59	3,300	5.0	660	27.5
VII	22, p.m.	46	105	27, a.m.	48	68	2,370	4.5	527	21.9
VIII	26, a.m.	51	111	31, a.m.	46	57	3,240	5.0	648	27.0
Total							22,050	38.0	4,700	195.8
Mean of 8 paths							2,756		588	24.5
Mean of 38 days									580	24.2

* November. † September.

Highs.—Five of the highs were first noted off the north Pacific coast, and the rest were first seen to the north of Montana. The general tendency was toward the lower Mississippi valley, and thence northeastward to the north Atlantic coast. Nos. I, II, and III were last seen off the New England coast, and IV, VI, VII, and VIII over Newfoundland, while V gradually disappeared in Wyoming.

No decided cold waves were experienced with these highs. A fall in temperature of 30° in twenty-four hours occurred at Moorhead a. m. of the 3d. At Denver, p. m. of the 15th, the temperature fall was 34°; at Dodge City, p. m. 24th, 36°.

Lows.—In the case of the lows not one began on the Pacific coast. There seems to have been an area of low pressure, rather permanent in Montana, and to the north and most of the lows started from this. No. I began as a hurricane in the West India Islands. (See the description of the hurricane of September 29–October 2, p. 439.) The general track of the lows was a little to the north of that of the highs, and six of them were last noted in the Gulf of St. Lawrence or Newfoundland. The highest winds of the month were as follows: 52 miles an hour at Savannah, a. m. of 2d, as No. I moved upon the coast; 64 miles at Charleston, and 60 miles at Savannah p. m. of 2d. On evening of 11th, as No. III moved down the St. Lawrence, Buffalo reported 52 miles. Eastport reported 56 miles p. m. of 15th, as No. IV moved up the Atlantic coast. Chicago reported 64 miles evening of 17th, as No. V moved to the Lake region. In connection with the same storm Cape May reported 56 miles evening of 18th. On the afternoon of 22d Buffalo experienced 56 miles an hour as low No. VI moved down the St. Lawrence.—*H. A. Hazen, Professor.*

RIVERS AND FLOODS.

The precipitation during the month of October was largely in excess throughout the watersheds of the navigable rivers, and, as a consequence, stages were much above the average for the time of the year. With a few minor exceptions navigation could have been continued almost uninterruptedly, and, in fact, it did continue, except from Memphis southward, where the quarantine regulations almost completely paralyzed it during the greater portion of the month. Otherwise, traffic was unusually active. An immense amount of coal, iron, and lumber products moved down the Ohio from Pittsburg, while on the Cumberland and the rivers of South Carolina the amount of business largely exceeded that of previous Octobers.

A few floods of limited duration and extent occurred during the month. The heavy rain of the 5th caused a marked rise in the Hudson with, however, but slight resulting damage beyond the temporary inconvenience to navigation. In the Hoosic Valley a cloudburst caused damage to an amount exceeding $25,000.

Heavy rains on the 4th caused a rapid rise in the Alabama and tributaries, and damage amounting to several thousand dollars was done to outstanding crops in the bottoms. Ample warning had been given of the rise, and all movable property was removed to places of safety. At Montgomery a stage of 28.8 feet was recorded, only 0.2 foot below that given in the warnings as likely to be reached.

General rains in the South Atlantic States on the 21st and 22d also caused moderate floods in the rivers of that district. At Richmond the James River overflowed most of the docks, but little or no damage resulted owing to the timely and accurate warning which had been given. A stage of 12 feet had been forecast, and 11.7 was recorded on the gauge.

In South Carolina the damage was limited for the most part to the retardation of the rice harvest.

The highest and lowest water, mean stage, and monthly range at 118 river stations are given in the accompanying table. Hydrographs for typical points on seven principal rivers are shown on the Chart. The stations selected for charting are: Keokuk, St. Louis, Cairo, Memphis, and Vicksburg, on the Mississippi; Cincinnati, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Forecast Official.*

Heights of rivers referred to zeros of gauges, October, 1898.

Stations.	Distance to mouth of river.	Danger line on gauge.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Mississippi River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
St. Paul, Minn	1,957	14	4.6	23–25	2.8	3–5	3.8	1.8
Reeds Landing, Minn	1,887	12	2.7	26, 27	0.3	1	1.4	2.4
La Crosse, Wis	1,822	12	3.7	30, 31	1.4	1–4	2.4	2.3
North McGregor, Iowa	1,762	18	3.1	31	0.6	1–5	1.5	2.5
Dubuque, Iowa	1,702	15	3.1	31	0.5	1	1.5	2.6
Leclaire, Iowa	1,612	10	1.7	31	0.4	1–10	0.8	1.3
Davenport, Iowa	1,596	15	2.8	31	0.8	1–11	1.4	2.0
Galland, Iowa	1,475	8	1.4	31	0.4	6–12, 14–16	0.7	1.0
Keokuk, Iowa	1,466	14	1.9	29	—0.4	6–11, 14–16	0.3	2.3
Hannibal, Mo	1,405	17	3.9	28	0.8	9–16	1.8	2.1
Grafton, Ill	1,307	23	5.9	30	2.4	14–16	3.6	2.6
St. Louis, Mo †	1,264	30	10.1	30	3.0	17	5.8	7.1
Chester, Ill	1,189	30	6.6	24, 25	1.3	18, 19	3.4	5.3
Cairo, Ill	1,073	45	16.5	31	7.6	10	11.1	8.9
Memphis, Tenn	843	33	8.9	30, 31	5.1	10, 23, 24	6.4	3.8
Helena, Ark	767	42	13.5	31	7.7	13	10.1	5.8
Arkansas City, Ark	635	42	14.7	22	10.5	16, 17	12.7	4.2